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ABSTRACT

This environmental unit is one of a series designed for integration within an existing curriculum. The unit is self-contained and requires minimal teacher preparation. The philosophy of the units is based on an experience-oriented process that encourages self-paced independent student work. In this particular unit, oaks and acorns are the vehicle by which primary school children discover the interrelationships of organisms in their environment. The unit is divided into four parts. In the first part, students work outside to collect and plant acorns and to observe their development into seedlings. Next, the students determine when acorns fall from the trees and discover the larvae living inside them. In the third part, the role of squirrels is studied in relation to the acorns. Lastly, the effect of climate on acorn germination is determined. These activities provide background information, materials needed, directions, and additional topics for teachers. (MA)

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Oaks, Acorns and People

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THE ENVIRONMENTAL UNITS

This is one of a group of Environmental Units written by the Environmental Science Center and published by the National Wildlife Federation.

In both theory and practice education is the essential base for long-range local, regional and national programs to improve and maintain the quality of environment necessary for man's welfare and survival. Citizens must be aware of ecological relationships in order to recognize, appreciate and fulfill constructive roles in society. This awareness should be launched through the existing educational process—in classroom and related school activities. No special courses on ecology can replace the need to integrate ecological learning throughout the existing curricula of our school systems. Furthermore, the life-styles and value-systems necessary for rational environmental decisions can best be acquired through repeated exposure to ecological learning which pervades the total educational experience.

It was with these thoughts that we developed these curriculum materials. They were designed for the classroom teacher to use with a minimal amount of preparation. They are meant to be part of the existing curriculum—to complement and enhance what students are already experiencing. Each unit is complete in itself, containing easy-to-follow descriptions of objectives and methods, as well as lists of simple materials.

The underlying philosophy throughout these units is that learning about the environment is not a memorization process, but rather an experience-oriented, experiment-observation-conclusion sort of learning. We are confident that students at all levels will arrive at intelligent ecological conclusions if given the proper opportunities to do so, and if not forced into "right" answers and precisely "accurate" names for their observations. If followed in principle by the teacher, these units will result in meaningful environmental education.

In the process of development, these units have been used and tested by classroom teachers, after which they have undergone evaluations, revisions and adaptations. Further constructive comments from classroom teachers are encouraged in the hope that we may make even more improvements.

A list of units in this group appears on the inside back cover.

About the National Wildlife Federation—1412 Sixteenth Street, N.W., Washington, D.C. 20036

Founded in 1936, the National Wildlife Federation has the largest membership of any conservation organization in the world and has affiliated groups in each of the 50 states, Guam, and the Virgin Islands. It is a non-profit, non-governmental organization devoted to the improvement of the environment and proper use of all natural resources. NWF distributes almost one million copies of free and inexpensive educational materials each year to youngsters, educators and concerned citizens. Educational activities are financed through contributions for Wildlife Conservation Stamps.

About the Environmental Science Center—5400 Glenwood Avenue, Minneapolis, Minnesota 55422

The Environmental Science Center, established in 1967 under Title III of the Elementary and Secondary Education Act is now the environmental education unit of the Minnesota Environmental Sciences Foundation, Inc. The Center works toward the establishment of environmental equilibrium through education—education in a fashion that will develop a conscience which guides man in making rational judgments regarding the environmental consequences of his actions. To this end the Environmental Science Center is continuing to develop and test a wide variety of instructional materials and programs for adults who work with youngsters.

Oaks, Acorns, Climate and Squirrels

An Environmental Investigation

BY

NATIONAL WILDLIFE FEDERATION

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

Design and Illustrations by

JAN BLYLER

An acorn falls from an oak tree. The acorn may get garnered by a squirrel and buried as part of his winter food supply; it may serve as home and food for the larva of a snout beetle; it may get covered over by leaves and transformed into a new oak seedling. Or, it may get picked up by a youngster, inspected, and used as the starting point for a whole series of investigations about ecology and the environment. This acorn and squirrel and snout beetle and oak tree furnish a small but significant model of environmental relationships. The activities in this unit are designed to provide some ways for you to help your students recognize for themselves the interdependence of all environmental neighbors.

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INTRODUCTION

This unit is concerned largely with oak trees and you will have to live in an area of the country where oaks are found in order to have your students carry out the investigations. In the first three parts, any oak will do. Generally, if you live on the west coast of the United States, or in the eastern half of the country extending as far west as most of North and South Dakota and parts of Kansas, Nebraska, Oklahoma and Texas, you will be able to do the first three parts of this unit. If you live outside the area, you will probably not have the oaks necessary to do the experiments.

In part four, the students will investigate the germination process of acorns. For these activities you will need to live in an area where there is at least one oak that **requires** a cold period for the germination of its acorns and one that **does not require** a cold period. All oaks are divided into two major groupings—red oaks and white oaks. Although there are some exceptions, acorns from red oaks usually must go through a winter or cold period before they can germinate, while acorns from white oaks do not usually require this cold period.

To have your students do the experiments in part four, you may use any of the white oaks in List A and any reds in List B.

List A	List B
White oak (east)	**Red oak (east)**
White oak (*Quercus alba*)	Northern red oak (*Quercus rubra*)
Post oak (*Quercus stellata*)	Southern red oak (*Quercus falcata*)
	Shumard oak (*Quercus shumardii*)
White oak (west)	**Red oak (west)**
Oregon white oak (*Quercus garryana*)	California black oak (*Quercus kelloggii*)

To help identify whites and reds, consult Figures 5 and 6. Lists A and B are broadly applicable for the geographic areas where oaks occur, but they are only partial listings. There are other oaks which are not named but which may be substituted for reds or whites in the germination activities. If you have some oaks which do not correspond to the drawings and descriptions, or if you are not certain whether you have one of each grouping, someone from your community or state university, or your local Agricultural Extension Agent should be able to help you.

The unit begins with an activity in which the students collect and plant some acorns. With this simple exercise, they will see that acorns come from oak trees and oak trees come from acorns—with the cycle repeating itself over and over.

Then the students will take a closer look at the acorns and determine, by gathering data and preparing graphs, the time period during which the acorns fall off the trees. The students will discover that some acorns have a larva growing inside them. This larva, which is deposited by an adult snout beetle, feeds on the acorn and will usually cause the acorn not to sprout. The students will see that for one reason or another, not all acorns become oak trees.

Squirrels, too, have an effect on the number of acorns that sprout—partly because the squirrels eat some acorns and partly because they "plant" some.

Finally, students will again plant some acorns, only this time they will give special attention to certain environmental factors. Here they will be able to discover some of the ways temperature influences germination. They will see that the acorns of some oaks sprout soon after they drop from the tree, but that others need to pass through a cold period.

All four sections in this unit may be done independently or simultaneously.

When the students in a class have completed the investigations in this unit, they should have a better understanding of some of the relationships of oak trees to acorns to squirrels to grubs to climate. We leave it to you to lead this into further adventures.

Oaks, Acorns, Climate and Squirrels

Acorns and Oak Trees

Locate several oaks that are within easy walking distance of the school. (You may want to consult a book of tree identifications before you begin.) The white oak (*Quercus alba*) is a very common and easily identified tree that does not require a cold period for germination; it would be a good one to use for this activity. If you are in an area where white oak (*Quercus alba*) is not found, you may substitute a number of other oaks of the white oak group. If you are uncertain about a particular tree's characteristics, someone locally should be able to help you.

The leaves of white oaks can usually be indentified by their lobes which are rounded on the ends. The red oaks, by contrast, are bristle-tipped. (See page 15.)

MATERIALS

plastic bags for collecting acorns
half-gallon milk cartons
potting soil mixed with sand
scissors

The children can clean and bring to school half-gallon milk cartons. Be sure to start collecting them early. You will want to cut off the tops of the cartons before the acorns are to be planted. The cartons make good planters, because the long roots of the oaks need a deep container.

Potting soil, sand, and plastic bags can be obtained from local merchants.

Mix the sand and potting soil. A good mixture is 1/3 sand to 2/3 soil.

I. COLLECTING THE ACORNS

Take the children on an acorn hunt early in the fall, as soon as the acorns begin to drop. When you get to the white oaks, or an appropriate substitute, give each child a plastic bag and let him hunt for five acorns and a leaf from the tree.

Encourage the children to select solid acorns, without holes. Even small, round drill holes in the acorn mean it should be rejected.

Ask the children where the acorns come from.

They may be able to spot some acorns still on the trees. If possible, collect a small branch with acorns on it for the class.

Ask what the acorns are. Many ideas may be presented, such as food for animals, seeds, etc.

If someone suggests that the acorns are seeds, ask how they can find out. Some children will be anxious to plant their acorns as soon as they return to school.

II. PLANTING THE ACORNS

Each child can fill his milk carton with the soil and sand mixture. The soil should come about an inch below the top of the carton, and can be moistened before the acorns are planted.

Each child should select his two best acorns and remove the caps. Both acorns can be planted in the same half-gallon carton but should be near opposite corners. To plant the acorns the children can stick

their thumbs into the soil (about one inch) to make a hole. You can describe this distance as "just past your knuckle." The acorn should be placed on its side in the hole and covered with soil. This method of planting should give the desired ½ inch of soil cover without being too complicated. Emphasize that the acorn should not be planted too deeply.

Place the cartons in a warm area of the room, and keep the soil moist (not soaking wet). You may want to punch some holes in the bottom and sides of the carton and place it in a dish for drainage. However, if you are careful with the amount of water you add and don't put the cartons in a very sunny area which would dry out the soil near the top, you probably won't need drainage holes.

In the meantime, leaves can be pressed and displayed with the extra acorns on the bulletin board. The acorns can be glued to bright pieces of paper before they are attached to the display.

III. HANDLING THE SEEDLINGS

As the seedlings develop, the children can compare the leaves with those they collected from the old oak.

ASK THE CHILDREN:

Are the new leaves similar to the old?
Can we draw a picture showing how new oak trees grow?

The children can draw a picture of the steps in the formation of an oak tree. These can be placed in a circle. Let them decide what the steps are and where to put the pictures.

Samples:

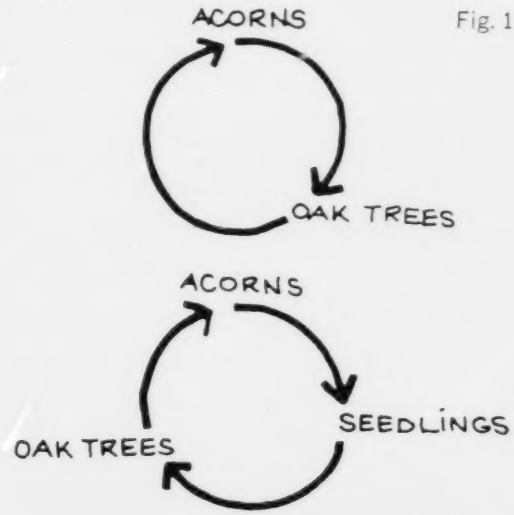


Fig. 1

In the spring the children can plant the seedlings in the schoolyard or at home. Old trees that have died can be replaced with the seedlings. The plantings should be marked and protected with rocks to prevent mowing and to keep people from stepping on them.

If storage of the seedlings becomes a problem, the children can take them home, or a local greenhouse might be convinced to keep them until spring.

Acorns

This investigation points out the importance of oak trees to many living things. The children will discover the time of year that acorns fall from the oaks, and what happens to them. They will compare the differences and similarities of various kinds of oaks, examining both acorns and leaves. They will also investigate the relationships between animals and acorns.

MATERIALS

small stakes—4 per child
string
small plastic bags
poster paper or primary chart paper
white glue
colored construction paper
cotton
large coffee can with lid
nutcrackers

I. WHEN DO ACORNS FALL?

When the new school year starts, select seven or eight oak trees which are close to one another. These should be within walking distance of the school. They do not need to be the same species of oak—in fact, it would be better if more than one kind were chosen. Thus, you might have three or four species of the white oak family and three or four of the red oak family.

Stake out four or five plots beneath each tree. These should be out under the branches. It is necessary to have the same number of plots under each tree. Also, the individual plots should correspond generally from one tree to another. In other words, if you have a plot near to the trunk of one tree, then you should have a plot at about the same distance and direction from the trunks of each of the other trees. In this way, your students will have a better basis for comparing total acorn fall among the several trees.

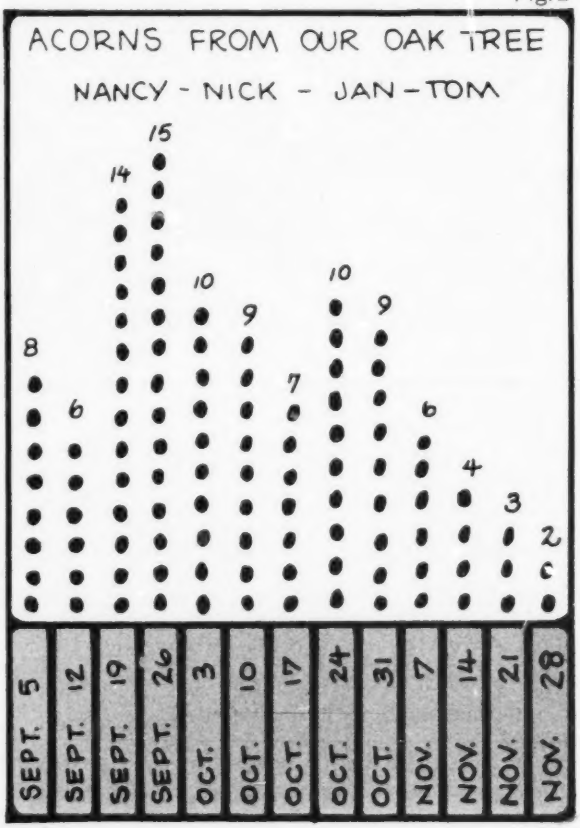
The plots should be about one yard (or meter) square. If small stakes (e.g., tongue depressors) are put into the ground at a low level, they can be left in place. Have the children put string around the stakes when the plots are being used, and remove it when they leave.

Assign one plot to each child. You will want to keep a record of these locations, possibly on a sketched map. Each child will collect all the acorns from his plot in a small plastic bag.

Select one day of the week for acorn collecting. The collecting should be done on this day each week throughout the autumn or until no more acorns are falling. Some trees may not drop any acorns. Let the children try to discover why they don't find any fresh acorns under certain trees, although they may find some old ones early in the fall. (Members of the red oak group require two years for the acorns to mature. Consequently, only some of them drop acorns in a given year.)

All of the acorns collected from one tree can be displayed in graph form in the following way: The children collecting from the same tree can work as a group, putting their acorns on a graph as shown in Figure 2. The graphs should be displayed throughout the study and can be made on stiff poster board, primary chart paper, or sheets of butcher paper. The poster board would be best since it will stand up when placed on a chalk tray or on a cabinet, and can be handled easily without tearing. The children can glue the acorns in a row above the collection date. The number of acorns in the row can be counted with the total number written at the top of the column.

Fig. 2



When the graphs are complete, discuss the results as follows:

- In what week did most of the acorns fall from your

tree? (Some variation may occur between the groups.)

- Are the trees that differ in numbers of fallen acorns the same kinds of oak trees? Why might the time of the greatest acorn fall be different for the same kinds of oak trees?

For this the children might consider the differences in the number they found in each plot under the same tree. Also consider the factors of wind, squirrels, position of the branches, etc. The class may want to select a two- or three-week period as the time when the most acorns fell.

II. TYPES OF ACORNS, LEAVES, AND OAK TREES

Ask the children to bring in acorns and leaves which they find near their homes. Encourage them to bring as many different kinds as possible, including *pieces* of acorns. Suggest to the children that if they collect acorns from different types of trees, it might be helpful to keep the acorns matched with the leaves of the same tree. You may want to gather some yourself. The acorns can be examined by the children in several ways:

- They could investigate whether all the acorns and leaves are alike or whether some are different. Different types can be displayed together in the room. If possible, several leaves from the parent tree should be displayed with each different type of acorn.

- They could discuss how the acorns from the different trees are different, and how they are similar. The leaves can also be compared.
- They could investigate whether both the leaves and acorns from one type of tree are distinctly different from those of another type of tree.
- They could see whether the leaves and acorns from a single kind of tree are exactly alike, or if they have differences too. Ask the class how they vary.

There's no need to tell the children the names of the kinds of oak trees until they have completed these observations. Having to know the names can sometimes stifle their curiosity instead of whetting it.

III. USES FOR ACORNS

A. Acorns Are Food

Ask: Do animals use acorns? How?

Some children will be aware that acorns are used for food, especially after gathering acorns, and having seen that some were chewed by animals.

Ask the children which animals eat acorns.

Can they find any pieces of acorns that an animal might have dropped?

The pieces can be glued to a large sheet of construction paper with the caption: Animals Eat Acorns. A list of the animals which the children know to be acorn-eaters can be included on the display. The children could also bring pictures of the animals to add to the display.

B. Acorns Are Homes

During the **peak** acorn fall, each child should collect acorns in an area under a tree which is not located in the survey plots. These should be kept separate from the other acorns they are collecting from the plots. Fifty should be a good number for each child to pick up during each collection period. The acorns should be picked up at random. Suggest to the children that they pick up whichever ones they happen to see without stopping to inspect and discard some. In this way they should get a fairly accurate cross-section of the acorns under the tree.

Examine the acorns carefully. Do any of them have a hole in the shell? Separate the ones with the holes from the ones without holes.

Each child can open his acorns to see what he finds inside. Nutcrackers will be useful for this. The students should save the shell chips and caps to make out a chart like the one in Figure 3, on the following page.

What did the acorns with holes have in them?

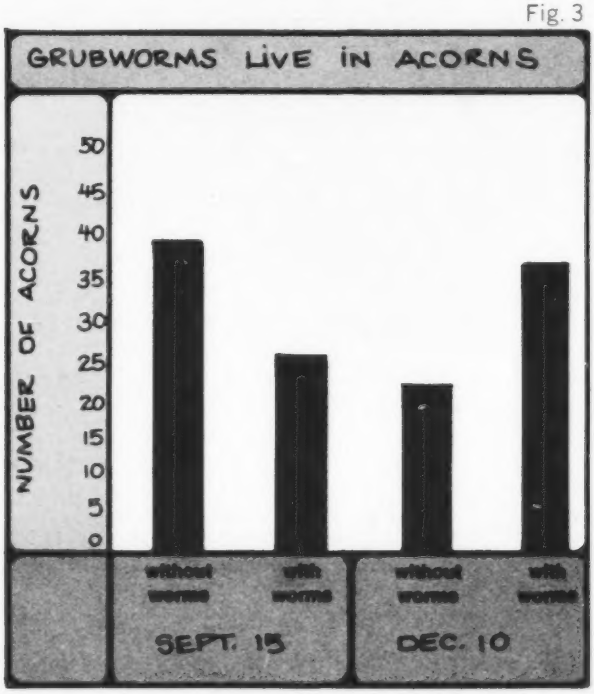
The female snout beetle makes a small slit in the acorn shell and deposits eggs through this slit. The eggs grow into grubworms which use the acorn for a protective covering and for food. When the grubworms have matured, they bore holes through the shell and exit through these circular "tunnels" they have made.

The acorns which have holes in them are the ones which have been vacated by at least one of the maturing snout beetles. In opening up the ones that have holes, the children can see if there are any other grubworms left within them. If the acorn has already been vacated, the children may want to examine the effects the grub had on the contents.

What did the acorns without holes have in them?

Have the class make a chart similar to Figure 3, which compares the number of acorns without grubs to the number of acorns with grubs. A separate chart should be made for each tree. Have them allow space on the chart for similar data they will gather in early winter. Chips of shells can be glued on the bars.

Fig. 3



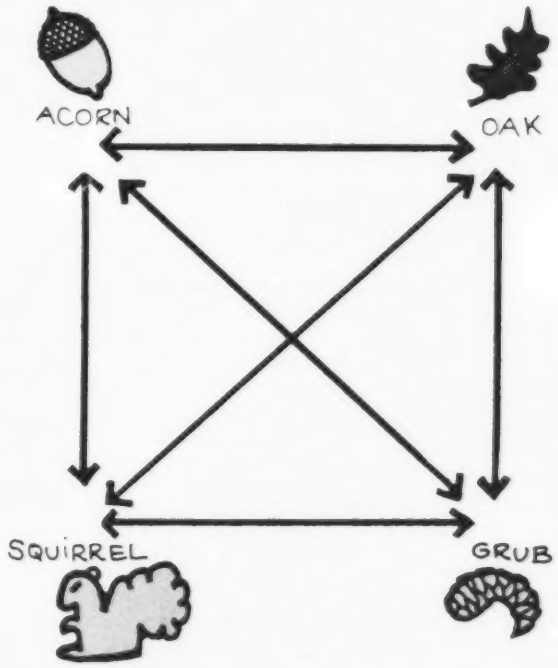
Have the class repeat the collection in early winter before it snows, examining the acorns again, and separating those with holes from those without. The children can add these results to their graph. Ask the students how the results compare with those from the early fall.

ASK THE CHILDREN:

What may have happened to the acorns that didn't have worms? (They were probably carried away by squirrels to store for the winter. Squirrels seem to be able to sort the good ones from the wormy ones.)

Do snout bettles seem to prefer particular kinds of oak trees? (This question can be answered by comparing the graphs from the different trees.)

What are the relationships between acorns, oaks, squirrels and grubworms? (The children can draw a chart showing these relationships and tell how they are related. A sample chart is below.)



The obvious relationships such as "the oak provides food and shelter for the squirrel" will be quickly noted. It may take some thought before the children realize there are reciprocal benefits for several of these relationships, e.g., "the squirrel transports the acorn and buries it, giving rise to new oak trees."

If the more complex relationships are not noted at this point, they will become apparent in later investigations. It's important to let the children discover them on their own.

What happens to the grubs in the acorns?

The children may want to see what the grubs become. To do this, about 30 "unmarred" acorns can be placed in a covered container with some moistened cotton and small air holes in the cover. The container should be plastic, metal, or glass.

The grubs need a cold period for development and should be kept in a refrigerator or on an outside porch for at least two months. After the cold period, remove the acorns from the refrigerator or bring them inside. Be sure to keep the cotton slightly moist. Open one acorn each week to check the development. Watch the cotton for the appearance of beetles.

Squirrel Watching

MATERIALS

book with pictures of squirrels
soft meterials—cloth, cotton, or paper
park map
masking tape
colored pencils or crayons
camera and film (optional)
feeder trays (optional)
food: nuts, acorns, fruits, corn
timers (3)
thermometers (3)
field glasses (optional)

Squirrels probably live near your school—especially if you've found oak trees.

Taking a class walk to look for them can be a very valuable environmental experience, and a lot of fun.

If you have a park near your school, use it for squirrel watching. This will lessen organizational and record-keeping problems.

When the children see a squirrel, have them look at it carefully.

Ask them what color it is.

Can the children name a color for each part? (If you have field glasses, they might be helpful in this exercise.)

EARS _____

HEAD _____

BACK _____

TAIL _____

STOMACH _____

EYES _____

Do all the squirrels look alike?

If some squirrels look different, have the class name the colors of their parts also.

When you go back to school, have the children look at pictures of different kinds of squirrels.

What kinds did the class see?

Were the squirrels that they saw all the same kind (according to the book), just a little different from each other, or were they different types completely?

I. WHERE DO SQUIRRELS LIVE?

When you are on your walk, the children should record where they see the squirrels.

PUT AN X FOR EACH SQUIRREL YOU SEE	
ON THE GROUND	
IN OAK TREES	
IN OTHER TREES	

If your class did the first investigation, "Acorns and Oak Trees," they will be able to recognize white oak trees by their leaves. If there are other types of oaks and the children have listed them as "other trees," that's fine. If the class did not do the first investigation, the "oak tree" category can be omitted altogether. It would still be a valuable activity, however, for the class to observe and record where squirrels are found.

A. Can You Find Squirrel Homes?

Some squirrels build large, round nests of leaves in the trees. These should be easy to find. The illustration shows what these nests look like. (See Figure 4 on the following page.)

Other squirrels live in holes in the trees. Watch the squirrels carefully to find these nests. On very cold days the squirrels will pick up soft paper, cloth,

or cotton, which you put out for them. If you watch quietly from a distance, the squirrel may carry the material to his nest. Why do the children think he would line his nest with the soft materials?

Nests in tree cavities or attics are hard to find in one day. More nests will be found as the year continues if the students remain alert to squirrel activities and can discuss their observations from home and school every week or so.

Fig. 4

B. Can You Map Squirrel Homes?

Using a map of the area around the school, the children may be able to locate and mark on the map each tree containing a squirrel's home. (Techniques for mapping the trees accurately are contained in **Outdoor Activities Collection**, another unit in this series.) Have the children number the trees in order to keep track of them.

If different kinds of squirrels are observed, the children should try to determine the type of nest inhabited by each one.

Have the students collect a small leafy twig from each nest tree. It should be labeled with the number of the tree from which it was taken. Use masking tape. If the leaves are too high to reach, have the children pick some up from the ground and compare them with those on the tree. They could also take a leaf identification sheet out to the tree and try matching leaf shapes.

The easiest method would probably be to take the leaves back to class and identify them with a simple picture key.

If the nests are in more than one kind of tree, color code the trees on the maps.

Example: Yellow = Oak with nest
Blue = Basswood with nest

ASK THE CHILDREN:

In which kind of tree are most nests found?

Are different types of nests found in different types of trees?

Do different kinds of squirrels live in different kinds of trees?

Are the leaf nests on the tips of the branches or in the forks of the limbs?

- Take some photographs of the nests to post in the room beside the picture of the type of squirrel.
- If the children find nests at home, post these pictures also.
- If some squirrels are found in attics or barns, photograph the buildings.
- While in the park, have the children draw pictures of the trees along with the location of the nests which are in them.

II. WHAT DO SQUIRRELS DO?

Look around the base of each tree. Can the class find some trees with little paths around them where the grass is worn away and the soil exposed?

Have the children use a leaf picture key to identify these trees and mark them and their type on the map. It might be helpful if each child has a dittoed leaf key for some of the more common leaves in your area. Have the children map the trees and paths.

ASK THE CHILDREN:

Are the trees with paths the same *kind of trees* as the trees with nests? Or different?

Are the trees with paths the *same trees* as the nest trees?

How do you think these paths were made?

Plan to stake out some spies at the beginning of the school day in the fall.

Each spy should sit quietly at a distance, viewing the tree with a path at the base. Two spies per tree would be best, so each can watch one side. They can watch about 30 minutes and record any movements of the squirrels, especially those movements which are related to the little pathway. They should also watch to see if the squirrels look for food and what they do with it. What kinds of food do they see the squirrels gathering?

ASK THE CHILDREN:

What kinds of sounds do the squirrels make?

When do they make them?

What does the squirrel's tail do when he is making a noise? (The class could make a record sheet.)

Can you tell what other ways the squirrel uses his tail?

III. WHAT DO SQUIRRELS EAT?

What things do squirrels eat?

Some things they like to eat best can be investigated by the children. Make some feeding stations for squirrels in a park, the schoolyard, or a neighbor's yard (at least three stations).

The park board might agree to have tray feeders attached to the trees. In any event, food can be placed on the ground.

The children can collect large quantities of acorns in the early fall. This should be done in an oak woodlot. If your class has a contest to see who can bring a lot of acorns, you should get plenty.

Also have them collect several different kinds of nuts and some fruits. You might, for example, try cherries, apples, crabapples, corn.

After the squirrels have become acquainted with the feeding stations (the corn and a few acorns will attract them), have the class investigate their preferences.

Place equal portions of two kinds of food on a feeder tray. (The trays should be cleared of other food beforehand.) The foods should be scattered in a random fashion on the tray.

Several children can watch each feeder from a distance. After a squirrel takes a piece of food the children should watch to see what he does with it.

Does he:

Eat it at the feeder?

Carry it up the tree to eat it?

Bury it in the ground?

Carry it to a hole in a tree to store it?

After the squirrel has either eaten or stored the food and is still away from the feeder, one child can check the feeder to see what was taken. This can be recorded by counting the numbers of pieces left or by estimating which kind of food remains in the greatest quantity.

When another squirrel appears (or the same one reappears), the same procedure can be carried out. The food preferences can then be rated in the order that the food is taken.

A data sheet can be used to record the information. When the children return to class, the information from the feeders can be compiled and the food preferences discussed.

IV. WHAT HAPPENS TO THE ACORNS?

Do the squirrels find the acorns they bury?

(Probably just two or three children should investigate this for squirrels might not "relax and bury" if there is too much commotion.

MATERIALS

6 nails (about one inch long) with heads
large ball of string: strength about double that of kite string
several popsicle sticks or some other small objects suitable as temporary markers
masking tape

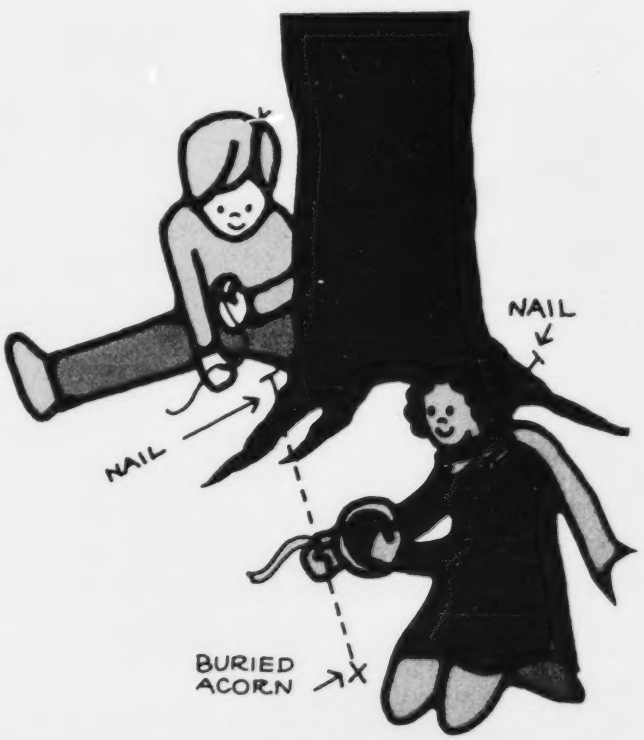
In the late fall, pile a large number of acorns on each feeder. Put in two nails at the base of each of two or three trees around which you feel the children may see squirrels burying acorns. Position the nails as shown in the drawing which follows and leave enough of the nail sticking up so that you will be able to hook a small loop of string on each nail head.

Note: The nails are small enough that they will not harm the trees. When the experiments are concluded, however, have the children remove the nails. Even though the holes are small, it would be a good practice if the children filled them in with a tree coating material. One of your students should be able to bring a small amount from home.

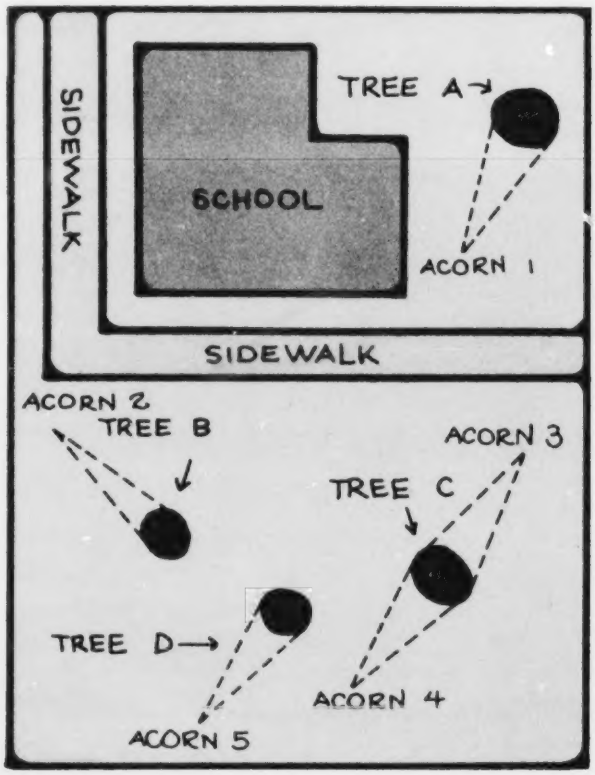
Each tree now has two nails. Next, have your students make a map of the area, labeling the feeders and numbering all the surrounding trees. On the map designate the trees containing the nails by lettering them A, B, C, and so forth. Put in such things as school buildings and sidewalks. This will help the students orient themselves when they use the map again a few months later. (See sample map on p.13.)

As the students keep a watch on the trees, remind them that they will have to be patient. It may take some time before they actually see a squirrel burying an acorn. When they do, they can mark each spot with one of the popsicle sticks. After they have noted several locations with these temporary markers, they can then mark the spots more permanently in the following manner:

In one end of the ball of string, tie a small loop and put it over one nail in a tree that is near the area where the acorns are buried. Unwind enough string to reach one of the acorns. Exactly over the spot where the acorn is buried, wind a piece of masking tape around the string. Now, with one student holding the tape over the buried acorn, a second student can take the ball of string back to the tree. Tie a second loop in the string and put it over the other nail, always keeping a slight tension on the string. Cut off the excess string. The string with the two loops should now form what is essentially a triangle from one nail to the acorn to the other nail. On the masking tape, write the letter of the tree you are using. Give the acorn a number and write this number on the masking tape also. Write the acorn number on the map showing its approximate location with relation to the tree you are using. Wind the string up and keep it. In the spring, this string will allow you to locate the spot where acorn #1 was buried. Make a separate string triangle for each of several buried acorns, and then wind the separate strings and keep them until spring.



In the late spring, have the class go back to the areas where the buried acorns were recorded. Using the map and the string for each respective tree and acorn, locate the point where the acorn was buried. Dig up each spot to see if the acorn is still there.



ASK THE CHILDREN:

Did the squirrels find all the acorns they buried?

How many did they find?

What may happen to the acorns the squirrels didn't dig up?

The oak trees furnish homes and food for squirrels. Do the squirrels affect the oak trees?

V. CAN YOU TRACE SQUIRREL TRACKS IN THE WINTER?

In the afternoon after a snowfall, have a track hunt.

Squirrel tracks should be abundant if the day is not too cold.

You may want to bring along a diagram of squirrel tracks.

ASK THE CHILDREN:

In which direction was the squirrel going?

Do you find signs of digging in the snow?

Have the children look for tracks between and at the base of trees. These can be drawn in on a map. Ask if some paths are worn in the snow between and around certain trees. Have the class map these too.

When you go back to school, compare the paths in the snow with the maps of squirrel homes which were made in the fall (if the paths and maps include the same trees and area).

Ask the class if the winter paths are in the same or different places than the paths around the bases of trees in the fall.

Repeat this activity after another snow. Have the children note whether the paths are in the same places or different ones.

Ask if this suggests a definite pattern in the movements of the squirrel.

Have the children watch from a distance to see what the squirrels are doing when they travel along the path.

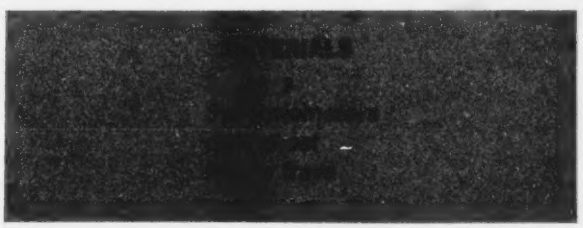
If the feeders are still being stocked with food, do the children think that these feeders seem to affect the movements of the squirrels?

Ask the students why they think that squirrels come to the ground in certain places.

VI. WHEN ARE SQUIRRELS THE BUSIEST?

Are the squirrels busy all day, or at certain times of the day?

This can be determined by a timed observation at the feeders in winter.



Divide the school day into fifteen-minute "watches."

If three feeders have been stocked, send three students for each "watch" (one for each feeder).

The children should record the temperature and time of day on their sheets, and keep track of the number of visits the squirrels make to the feeders. Since a squirrel may sit in the feeder eating for quite some time, the children may want to record the time spent in the feeder as well.

They can record any other activity they observe.

A chart can be made for the class observations. A sample format might look like this:

Time	no. of visits			time at feeder (sec.)			Temp.			other activities		
9:00-9:15	1 1 1 1	1 1 1		7 4 3 5	6 10 14		68°	70°		chattering	eating	
9:16-9:30												
9:31 9:45												
9:46 10:00												
Feeder	1	2	3	1	2	3	1	2	3	1	2	3

ASK THE CHILDREN:

Were the squirrels more active at certain times of the day?

What could they have been doing when they weren't at the feeders?

If this activity is done on a very cold day and again on a warmer day, the effect of temperature on the activity of the squirrels can be compared.

Seasonal comparisons could also be investigated if the activity is performed in the fall, winter, and spring.

Oaks and Climate

MATERIALS

plastic bags or grocery sacks
half-gallon milk cartons (4 per child)—if this is not possible, see "Alternatives" section.
sand (enough to fill a large grocery bag)
rich potting soil (enough to fill the cartons)
refrigerator (maybe you can use one in the lunchroom)
two containers for cold storage of acorns (must be waterproof and able to be covered. Large plastic bags will do.)
primary chart paper
construction paper (one sheet for each tree)

This investigation involves the collection and planting of acorns from two kinds of oak trees—that is, one tree from the red oak grouping, and one from the white. It is similar to the activity which launched this unit, but it proceeds to more sophisticated concepts.

Questions the children will investigate:

- Where do the acorns come from?
- Where do oak trees come from?
- Are all oak trees alike?
- Do some oak trees need certain weather conditions for their seeds to sprout?
- What does winter do to acorns?

I. COLLECTING THE ACORNS

Do this in **early** fall when leaves are still present and acorns abundant. Using Lists A and B from the Introduction and the diagrams in Figures 5 and 6 to identify trees, locate at least one oak from the red oak group and one from the white oak group. Ideally they should be within easy walking distance of the school. The red oaks will not all be releasing acorns, because these are only dropped every two years.

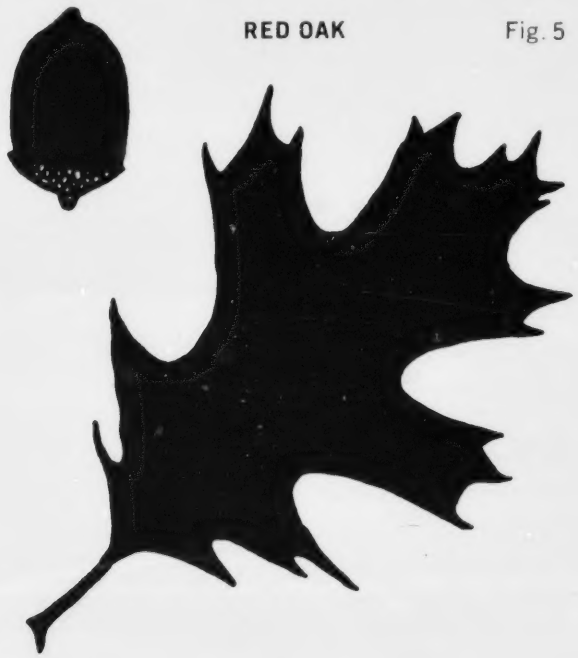
Take the children out to collect enough acorns so that every child has four acorns from a red oak and four from a white oak. Point out that these acorns are going to be planted. In order to increase the chances of getting acorns that will sprout, the students should look for ones that appear freshly fallen —clean, not spattered with mud, etc.

The acorns should be collected in labeled bags. If you do not want to tell the children the **names** of the trees, number the bags. The children should make sure the acorns are not worm-infested by checking for small holes on the surface. If no holes

are apparent, they are probably all right (the worms would have "evacuated" through the holes after eating the interior of the acorn). The children can collect leaves from each tree and put them in the bag with the acorns which were collected from that tree.

Display the leaves and a few acorns from each tree. These could be mounted on separate sheets of construction paper. After the children have observed them, discuss where the acorns came from and the differences between the leaves and acorns of the different trees. The children should be able to group the samples into two kinds of trees. After they have grouped them, you can show the children the diagrams in Figures 5 and 6. This should enable them to identify the names of the trees and label the display.

RED OAK Fig. 5



WHITE OAK Fig. 6

II. PLANTING THE SEEDS

A. Outline

The same procedure should be used for each kind of seed. Plant them in half-gallon milk cartons with only the tops of the cartons removed. Each container should be labeled as red oak or white oak, cold or warm, along with the names of the children. Here is a rough outline of the procedure the students will be following:

RED OAK ACORNS

4 per student

Keep 2 in cold storage
35-45 days

↓

Then plant in milk cartons
keeping in warm place
2 acorns per carton
1 carton per child

Plant 2 immediately
in milk cartons
keeping in a warm place
2 acorns per carton
1 carton per child

WHITE OAK ACORNS

4 per student

Keep 2 in cold storage
35-45 days

↓

Then plant in milk cartons
keeping in a warm place
2 acorns per carton
1 carton per child

Plant 2 immediately
in milk cartons
keeping in a warm place
2 acorns per carton
1 carton per child

B. Detailed procedure following the outline (to be repeated for both types of acorns)

Plant ½ of the "white" acorns and ½ of the "red" acorns immediately, using these directions:

1. Remove the caps from the acorns.
2. Using two milk cartons, each child can plant 2 of each kind of acorn. In one carton, he plants 2 acorns from the white oak group. In the other carton, 2 acorns from the red oak group. The acorns should be placed on their sides about ½ inch beneath the surface of the soil, and as far apart as possible. The soil should be rich and moist, and mixed with some sand.
3. Store the cartons in a warm place in the classroom, keeping the soil moist, but not saturated.
4. Watch for germination and keep a record of the sprouting times for each kind of seed. A large chart similar to Figure 7 can be posted for recording the results.

Store the remaining half of the "white" and "red" acorns in the cold before planting, using these directions:

1. Remove the caps from the acorns.
2. Each child in your class can place 2 acorns in one large container of moist sand. All of the acorns from one type of tree can be placed in one container, and all the acorns from the other tree type in another container. Both containers should be labeled and may be covered. Vermiculite can be used in place of sand.
3. Store the containers in a refrigerator at a temperature of 32° to 38° F. for 35 to 45 days, simulating winter. Be sure to record any acorns which sprout in the refrigerator.
4. After the cold period, each child can plant 2 of each kind of acorn—2 "reds" in one milk carton, and 2 "whites" in another milk carton. Use the same type of soil as with the acorns planted in the preceding section. The acorns should be on their sides, ½ inch beneath the surface of the soil.
5. Store the cartons in a warm place in the classroom, keeping the soil moist, but not saturated.
6. Record the sprouting results on the large chart. They should sprout after 30-60 days.

C. Alternatives

If you do not have space for all of the milk cartons in your classroom, the children could take them home; however, many may be lost if this is done.

You could plant all of the acorns in flats or large trays if this would eliminate the storage problem. If necessary, the total number of acorns per student could be reduced to four.

Acorns for each child:

Red Oak	1 cold, 1 warm
White Oak	1 cold, 1 warm

Each child can plant his acorns in the proper trays. Four trays would be necessary:

Red Oak cold	White Oak cold
Red Oak warm	White Oak warm

III. DISCUSSION

Results from the acorns which were planted immediately will materialize first. As these are recorded, ask: Does one kind of acorn seem to be sprouting more than the other? Which one?

After the acorns from the cold treatment have sprouted and the results are recorded, initiate a discussion.

ASK THE CHILDREN:

Does one kind of acorn need to go through a cold period before it can sprout? Which one?

Did any acorns sprout while they were in the cold? If so, which ones?

Could the acorns that sprouted after going through the cold period sprout in a place where there was not a cold winter?

Is your area a good place for oaks which have acorns that require a cold period before they can sprout?

Does one kind of acorn sprout without a cold period? If so, which one?

Did chilling the acorns that did not require a cold period keep them from sprouting when they were warm again?

What does winter do to the acorns that do not require a cold period?

Is your area a good one for oaks which have acorns that do not require a cold period before they can sprout?

When the seedlings are well developed, and the warm spring weather has come to stay, the children can plant their oaks in an area on the schoolyard or at home. The trees could also be planted to replace old trees that have died and have been removed. The children should mark the location, by placing rocks around the young seedlings. This will prevent mowing and keep people from stepping on them. Care should be taken when transplanting the seedlings, because they have extremely long taproots.

SPROUTING CHARTS

Figure 7

WHITE OAK

Warm			Cold		
Date Planted	Date Sprouted	Total Days	Date Planted	Date Sprouted	Total Days

RED OAK

Warm			Cold		
Date Planted	Date Sprouted	Total Days	Date Planted	Date Sprouted	Total Days

COLOR CHART FOR SQUIRREL OBSERVATION

EARS _____

HEAD _____

BACK _____

TAIL _____

STOMACH _____

EYES _____

CHART FOR RECORDING WHERE SQUIRRELS LIVE

PUT AN X FOR EACH SQUIRREL YOU SEE	
ON THE GROUND	
IN OAK TREES	
IN OTHER TREES	

CHART FOR CLASS OBSERVATION

Time of Observation	No. of Visits			Time at Feeder			Temperature			Other Activities		
9:00- 9:15												
9:16- 9:30												
9:31- 9:45												
9:46-10:00												
Feeder #	1	2	3	1	2	3	1	2	3	1	2	3

COMPOSITE LIST OF MATERIALS

plastic bags
half-gallon milk cartons
rich potting soil
scissors
small stakes
string
poster paper or primary chart paper
white glue
colored construction paper
cotton
large coffee can with lid
book with pictures of squirrels
soft materials—cloth, cotton, or paper
park map
masking tape
colored pencils or crayons
camera and film (optional)
food: nuts, acorns, fruits, corn
feeder tray (optional)
timers (3)
thermometers (3)
field glasses (optional)
sand
refrigerator
nutcracker

THE ENVIRONMENTAL UNITS

Below is a list of the twenty-four titles in the Environmental Discovery Series. Next to the titles, we have suggested the grades for which each is most appropriate. We emphasize that these are suggested grade levels. The teacher is encouraged to adapt the activities to a wide range of grade levels and subject areas depending upon the interests and abilities of the students.

Order No.	Title	Grade Level	Price	Order No.	Title	Grade Level	Price
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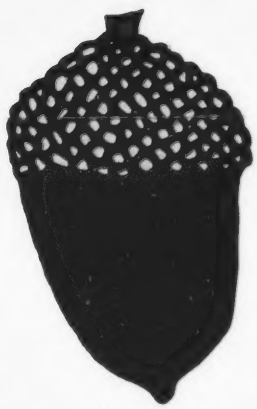

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